



LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

Turbulence Kinetic Energy Budgets and Dissipation Rates in Disturbed Stable Boundary Layers

J. K. Lundquist, M. D. Piper , B. Kosovic

March 30, 2004

16th Symposium on Boundary Layers and Turbulence
Portland, ME, United States
August 9, 2004 through August 13, 2004

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

Turbulence kinetic energy budgets and dissipation rates in disturbed stable boundary layers

Julie K. Lundquist, Mark D. Piper, and Branko Kosovic

Numerical simulations of the stable atmospheric boundary layer are challenging due to the wide variety of phenomena which can affect a stable boundary, including density currents, breaking Kelvin-Helmoltz waves, and gravity waves, among others. To improve the simulations required by numerical weather prediction models, several new parameterizations have recently been proposed by Cheng, Canuto, and Howard (2002) and Freedman and Jacobson (2003), among others.

We evaluate turbulent kinetic energy (TKE) budgets, the TKE dissipation rate, and the TKE dissipation length over a range of stability regimes represented by a developing stable boundary layer, intrusions (by a cold front and by a density current) into the stable boundary layer, and post-intrusion restabilization, using data from the MICROFRONTS and CASES-99 field experiments. The observations are compared with standard (Louis, 1979) and more recent parameterizations (Freedman and Jacobson, 2003; Cheng, Canuto, and Howard, 2002).

Support for MP from the Atmospheric Sciences Division, Mesoscale Dynamics Program of the National Science Foundation, under grant ATM-9903645, is acknowledged. The LLNL component of this work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.